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Szentmihalyi et al.

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(54) **METHOD FOR PRODUCING AN INTERNAL OR EXTERNAL PART OF AN OPPOSED TRACK JOINT**

29/557, 558; 464/145, 182, 902, 906;
148/220

See application file for complete search history.

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(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Division of application No. 12/348,556, filed on Jan. 5, 2009, now abandoned, which is a continuation of application No. PCT/DE2007/001194, filed on Jul. 5, 2007.

(30) **Foreign Application Priority Data**

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Aug. 12, 2006	(DE)	10 2006 037 847
Jul. 3, 2007	(DE)	10 2007 030 898

(57) **ABSTRACT**

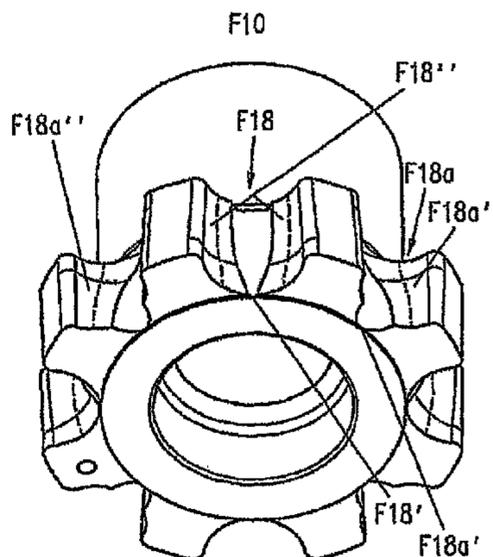
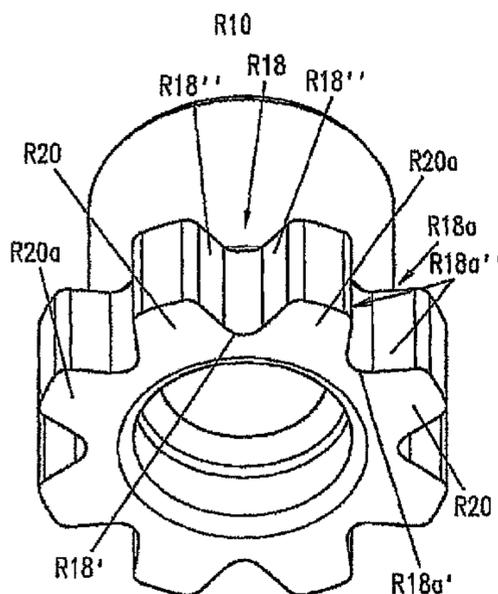
A method for producing an internal or external part of a torque-transmitting opposed track joint, such as a fixed constant velocity ball joint, in which approximately axially parallel extending track bases of the joint tracks have curvatures which deviate in their axial course from the curvatures of the ball contact lines. The method is characterized in that in a first step a perform with approximately axially parallel extending grooves having lateral flanks is produced, and in a second step the perform is formed into a final joint part whereby the lateral flanks of the grooves are just partially formed to achieve the ball contact lines.

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B21K 1/04 (2006.01)

(52) **U.S. Cl.**
USPC **29/898.066**; 464/145

(58) **Field of Classification Search**
USPC 29/428, 893.1, 893.3, 898.06, 898.066,

10 Claims, 7 Drawing Sheets



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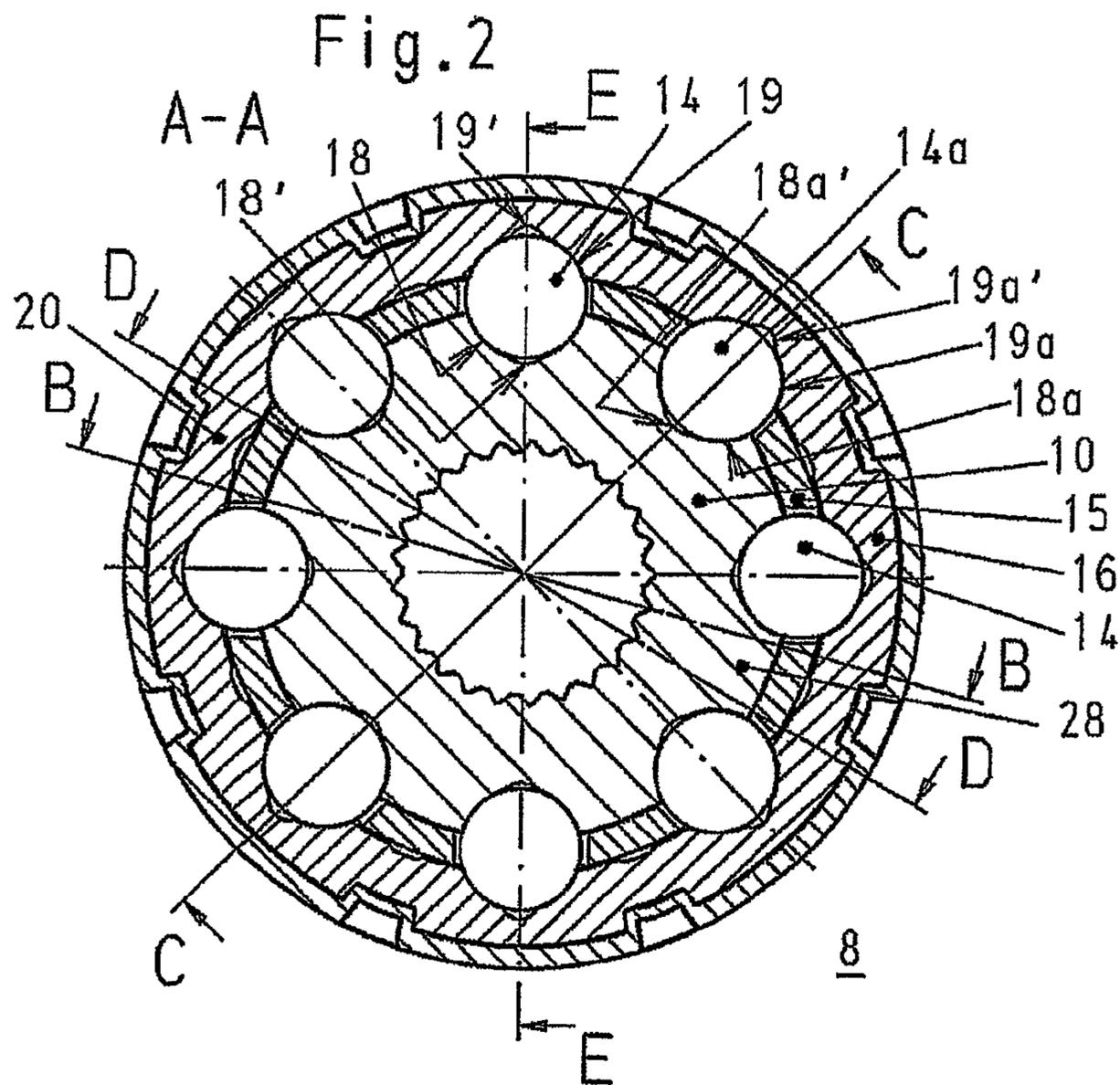
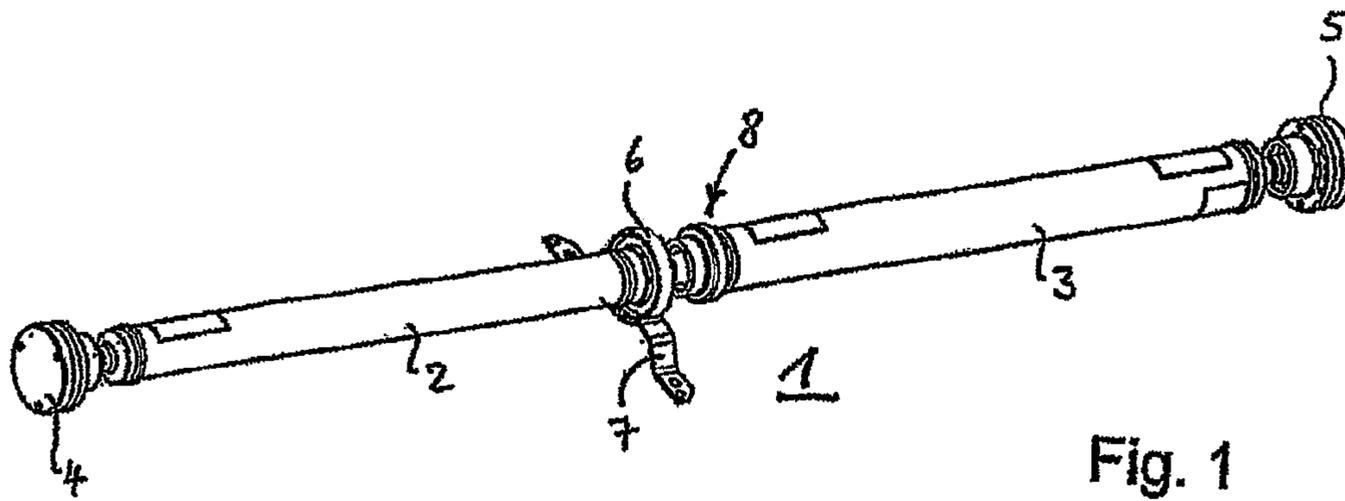
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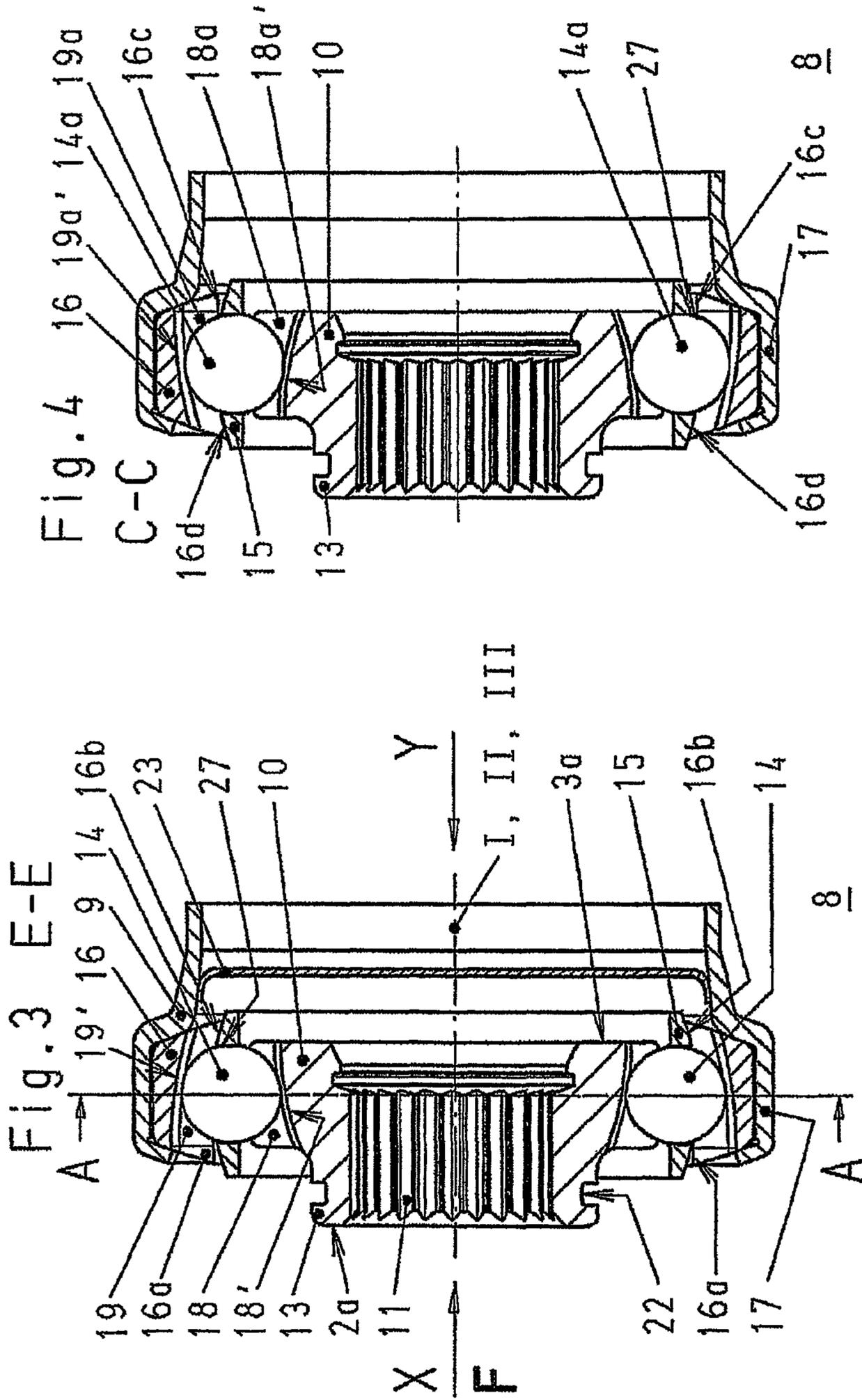
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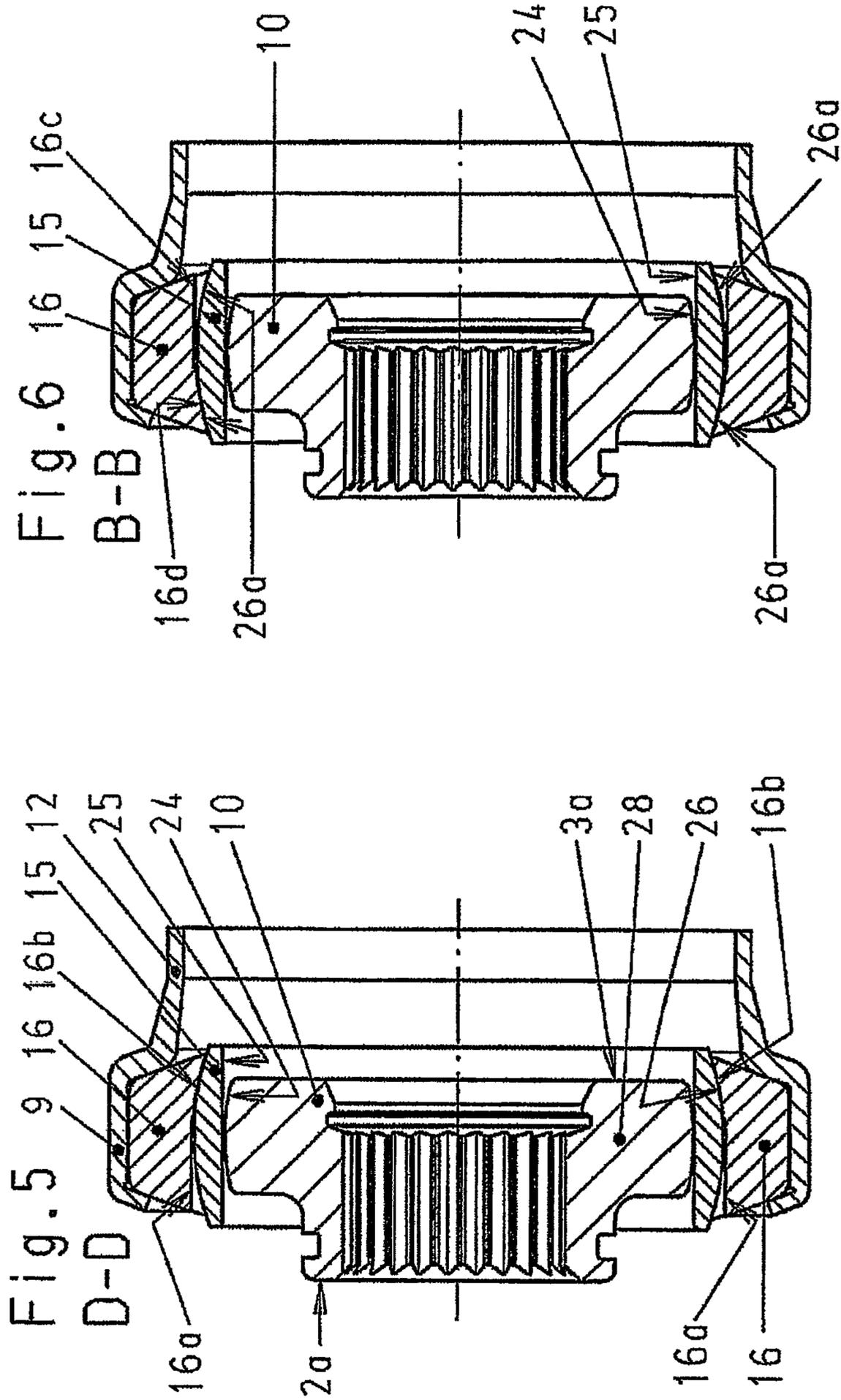
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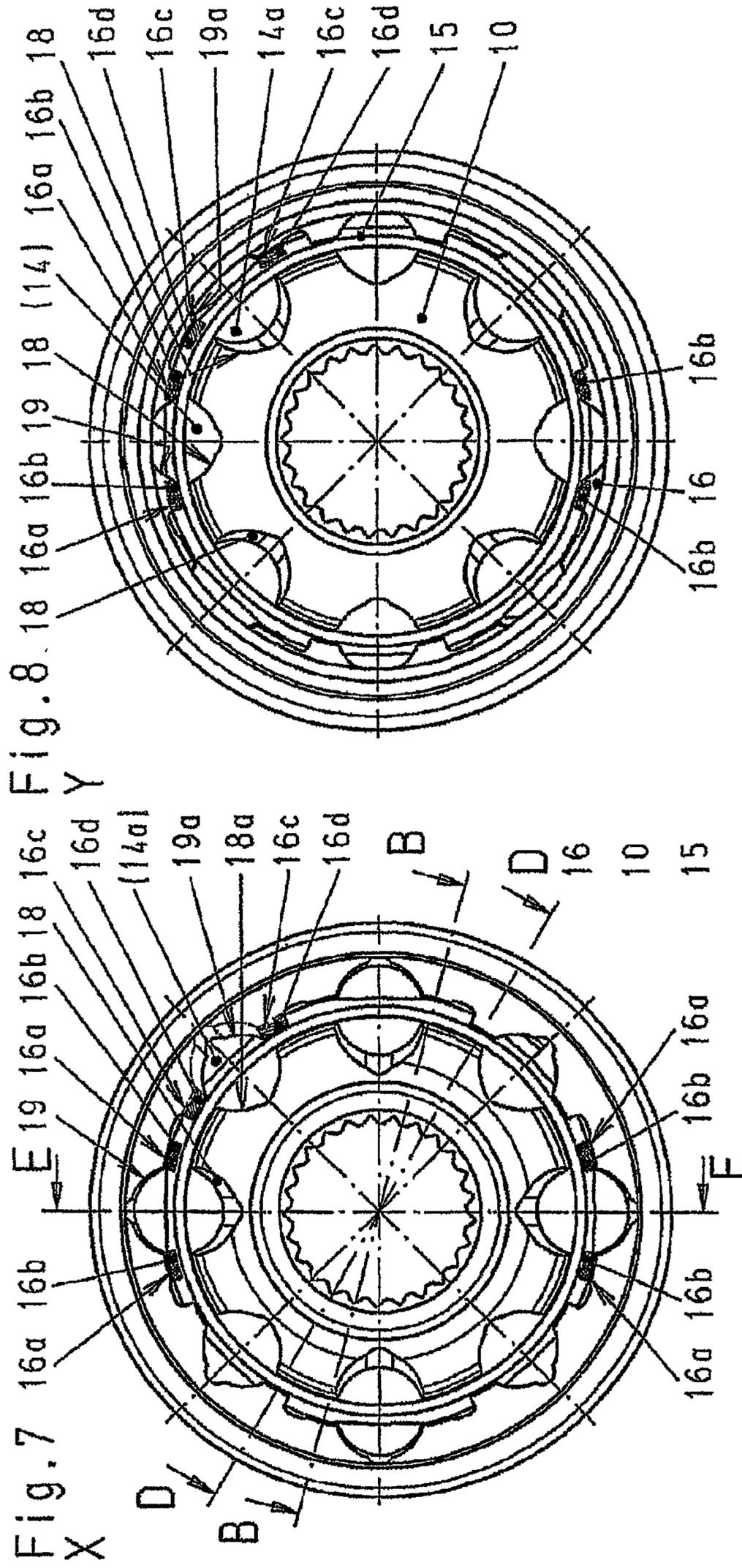


Fig. 7 16a 16b 16c 16d (14a) 19a 18a 16c 16d B D 16 10 15 X E 19 16a 16b 18 16c 16d Y

Fig. 8 18 16a 16b 19 18 (14) 16a 16b 18 16d 16c 19a 14a 16c 16d 15 10 16b 16 16b

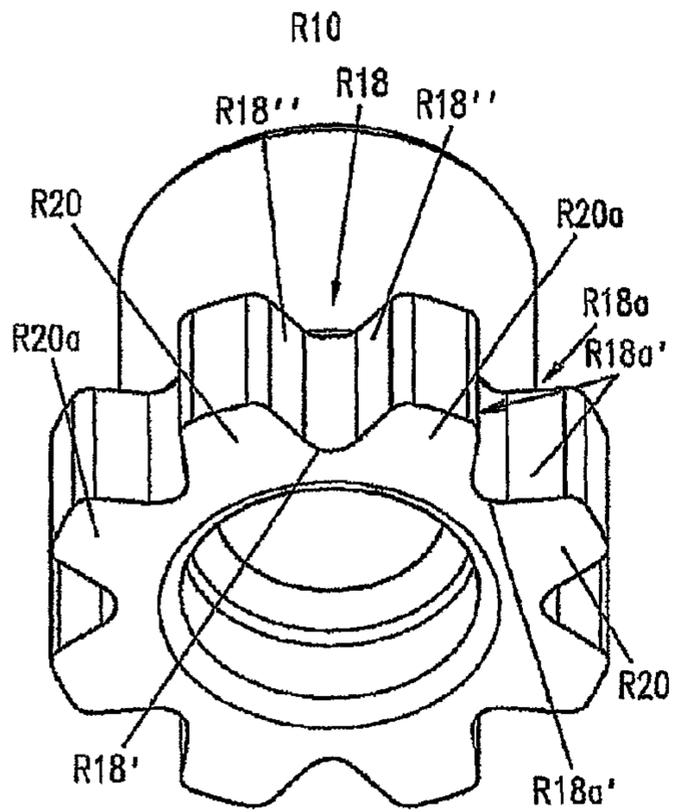


Fig 9

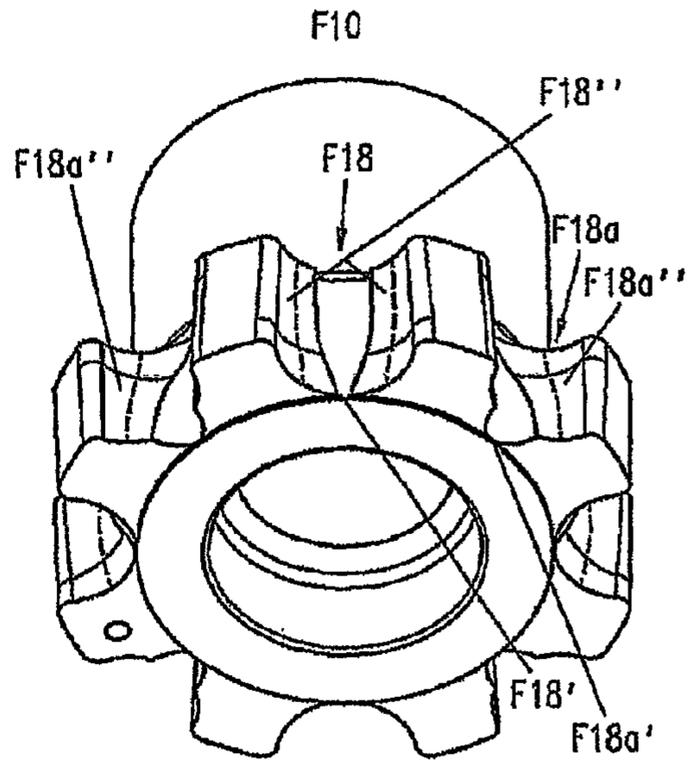


Fig 10

A-B

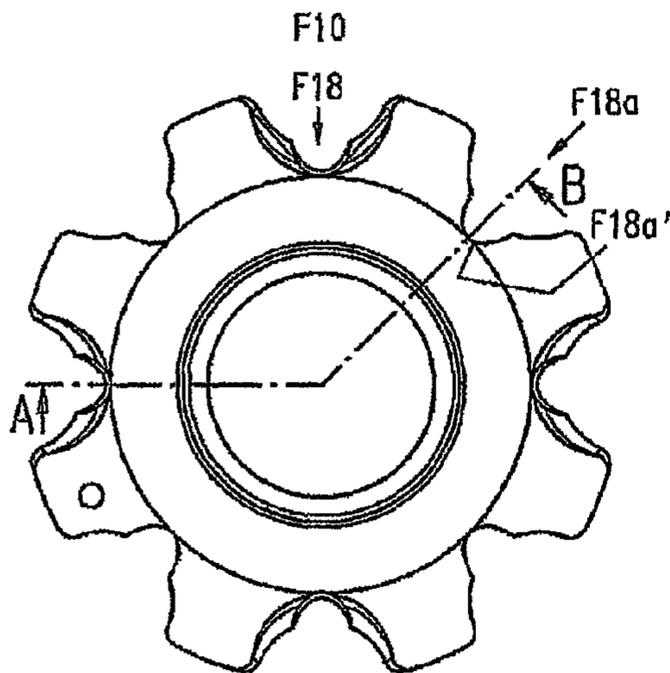


Fig 11

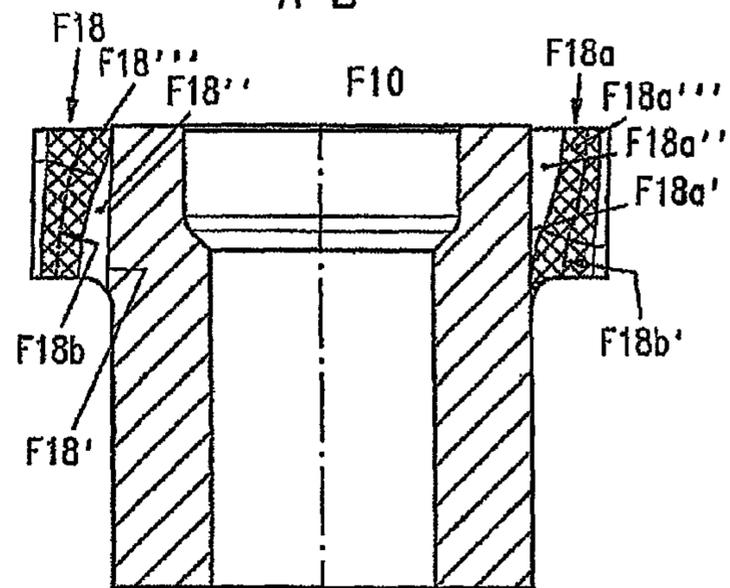


Fig 12

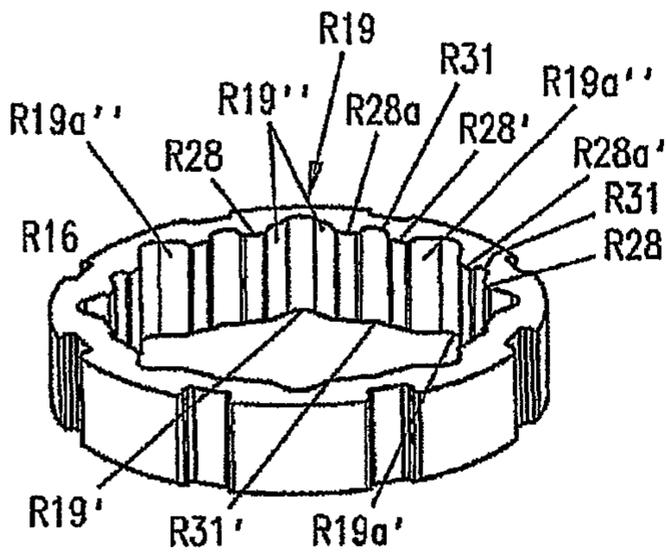


Fig 13

A-A

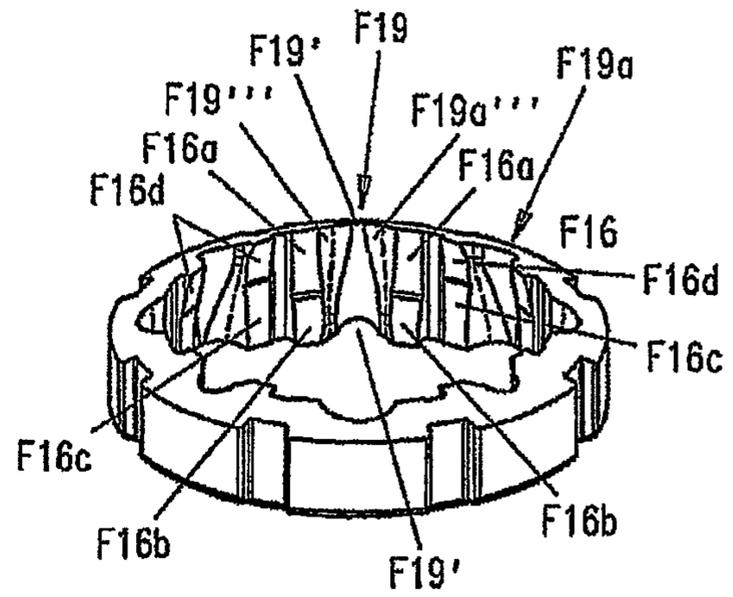


Fig 14

B-B

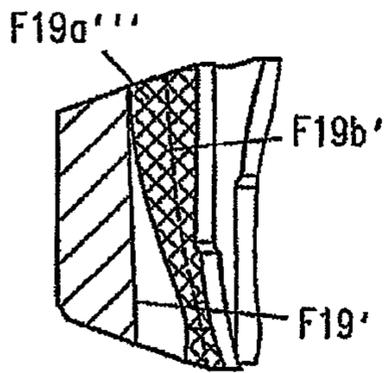


Fig 16

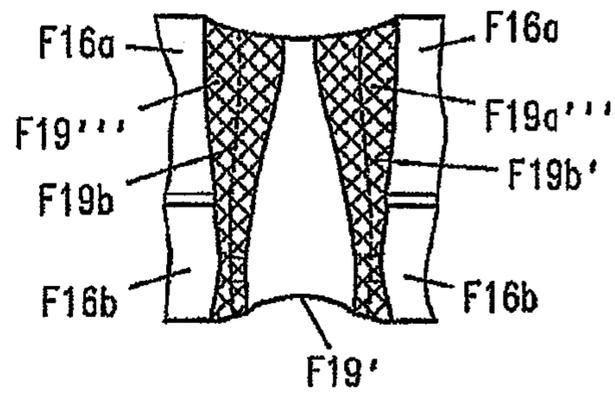


Fig 17

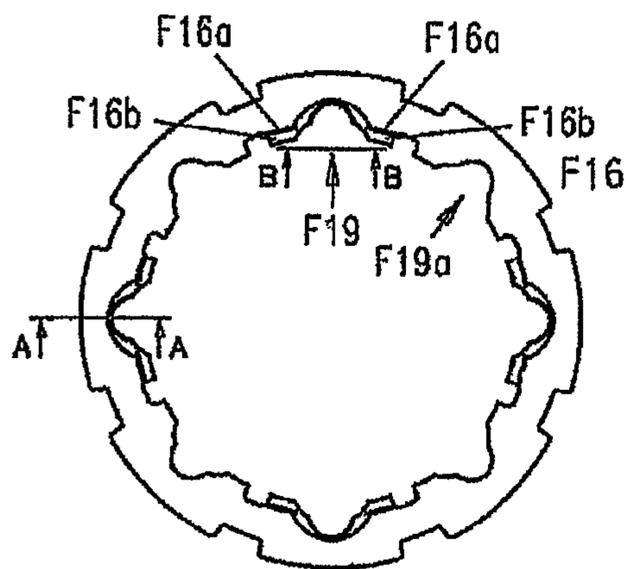


Fig 15

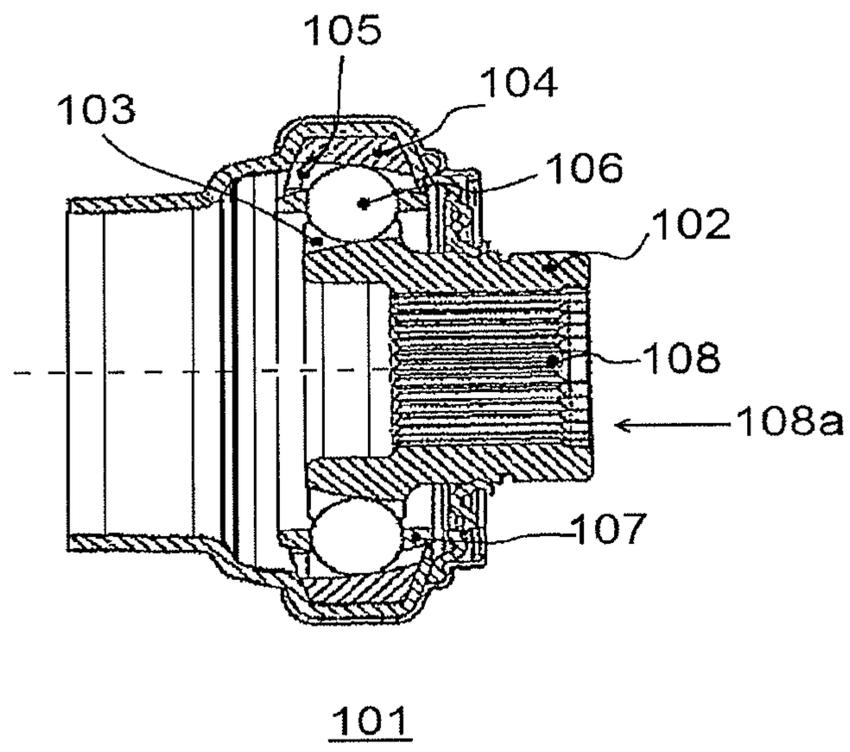


Fig. 18

**METHOD FOR PRODUCING AN INTERNAL
OR EXTERNAL PART OF AN OPPOSED
TRACK JOINT**

CROSS REFERENCE TO RELATED
APPLICATIONS

This application is a division of application Ser. No. 12/348,556, filed Jan. 5, 2009, now abandoned, which in turn was a continuation of international patent application no. PCT/DE2007/001194, filed Jul. 5, 2007 designating the United States of America and published in German on Jan. 10, 2008 as WO 2008/003306, the entire disclosure of which is incorporated herein by reference. Priority is claimed based on Federal Republic of Germany patent application nos. DE 10 2006 031 002, filed Jul. 5, 2006; DE 10 2006 037 847, filed Aug. 12, 2006 and DE 10 2007 030 898, filed Jul. 3, 2007.

BACKGROUND OF THE INVENTION

The invention relates to torque transmission devices, such as fixed, constant velocity ball joints as opposed track joints having

a joint external part having external tracks,
a joint internal part having internal tracks,
torque-transmitting balls, which are accommodated in track pairs made of external tracks and internal tracks,
a ball cage having cage windows, in which balls are retained and guided upon deflection of the joint,
first external tracks forming first track pairs, in which first balls are retained, with first internal tracks,
second external tracks forming second track pairs, in which second balls are retained, with second internal tracks,
the first track pairs and the second track pairs forming ball contact lines having opposing curvatures,
the external tracks and the internal tracks being delimited by external and internal track bases.

In practice, the ball raceways and/or running channels in opposed track joints as described, for example, in U.S. Pat. No. 6,872,143 (=DE 102 20 715) are produced by chip removal.

It has already been suggested in U.S. Pat. No. 7,396,284 (=DE 102 09 933) that the external tracks or running channels be formed in a chipless manner.

The chip-removing production according to U.S. Pat. No. 6,872,143 is primarily complex, and requires costly machines and long machining times. It also causes significant waste and quality losses in regard to the strength, because the material flow lines in a joint internal or external part produced as a preform by forging, are cut through by the machining.

To produce the ball raceways in joints such as those of '933 chipless, the prior art describes the possibility, for example, of providing hot-cold or warm-cold processes, a preform being produced within a forging procedure, for example, and the required precision being achieved in a cold calibration process.

Because it is an opposed track joint, differing tools each having opposing ball raceways must already be provided for the production of the preform for such a process. The precision of the parts is also limited by the guiding precision of the machine.

The unavoidable indexing irregularity in the preform also can no longer be remedied in the following machining steps.

A tool having the same irregularities is also required for the calibration process for each of the different ball raceways.

SUMMARY OF THE INVENTION

The present invention is based on the object of avoiding these disadvantages and allowing cost-effective and high-

quality production of internal and/or external joint parts and thus of fixed, constant velocity joints, in that investment costs for complex and costly machines are avoided, tool wear is reduced, and short machining times are ensured with an optimization of the quality, in particular also in regard to achieving higher torque transmission values. Furthermore, the indexing precision is to be improved and waste-free production, in particular of the ball raceways, is to be made possible, so that machining times, in particular machine run and handling times, are reduced. Moreover, higher carrying capacities are to be achieved and waste is to be avoided.

In addition, the invention was based on the further object of providing torque transmission devices, which have high strengths and thus allow the transmission of high torques at high precisions, i.e., optimum fitting and optimum smooth running, as well as cost-effective and efficient production, and by which the service life of assemblies, machines, and devices equipped with components of this type is increased.

The first part of the statement of the object is achieved according to the invention by constructing the joint external part and/or the joint internal part in such a way that the curvatures of the track bases—viewed in their axial course—at least partially deviate from the curvatures of the ball contact lines, the term “lines” also comprising planar areas or combinations of lines and surfaces in the tracks and/or running channels. It may be advantageous if the track bases—viewed in the axial direction—run partially at least approximately axially parallel.

In other words, according to the invention the tracks no longer need to be completely deformed over the entire axial distance, but rather only where this is necessary to achieve the ball contact lines.

The joint internal part and/or the joint external part are advantageously produced in a chipless manner as a preform in a forming tool and provided with at least approximately axially-parallel grooves and projections as pre-formed contours to form the ball contact lines.

The preform may be produced by forging, for example, such as a cold and/or hot forging method or also by other shaping methods, such as sintering.

The ball contact lines of the joint internal part and also the joint external part may be formed by chipless deformation of the projections and/or grooves in a molding tool. This deformation may be performed in a calibration tool, in which the ball raceways and/or contact lines may be geometrically finished-formed, so that they do not need to be machined.

During the production of the ball contact or running lines, along which the balls move upon the deflection of the joint, specific axial areas of the grooves or groove bases and/or notches formed during the production of the preform are expediently not deformed by the calibration tool, so that their structure, which runs at least approximately axially, is partially maintained over the axial course of the finished external and/or internal tracks of the joint external part and/or the joint internal part. This provides the advantage of less deformation work, inter alia.

Furthermore, the invention relates to a method for producing fixed, constant velocity ball joints, which is distinguished in that the tracks of the joint external part and/or joint internal part are produced by reshaping in a preform, i.e., by cold and/or hot reshaping, in that firstly at least approximately axially-parallel notches are produced, the ball raceways are subsequently at least approximately finished geometrically in opposing directions, preferably also by reshaping technology, e.g., in a compression or calibration procedure, without machining being required.

Both the preform and also the opposing course of the ball contact lines may each be produced in one work step and by cold and/or hot reshaping, it being able to be advantageous if the final work procedure is a calibration procedure, so that at least then the ball raceways of the joint part no longer have to be machined (even after a hardening method, e.g., case hardening).

Due to the production firstly of a preform having notches running at least approximately parallel in the axial direction and subsequent deformation thereof into ball raceways having the contact and/or running lines for the balls, firstly waste-free production is ensured and thus cost-effective and efficient production and furthermore high indexing precision is achieved, specifically by the tools themselves. The machine itself does not require precise guiding, because the projections and/or grooves of the preform, which run at least approximately axially-parallel, have been predefined by a single tool and during the finish molding of the ball run lines, the shaping fingers of the tool practically thread themselves.

Special advantages result, as already noted, if the preform is produced in a single tool, because then the indexing precision of the part itself comes out just as well as the indexing precision of the tool and this may be very high, because the tool is not divided.

Furthermore, none of the separate guides for each tool half otherwise necessary for divided tools are required for such an operation.

Also during the calibration operation, which forms the restriction and thus the ball raceways or running lines from the preform, the guiding of the tools to one another may be performed by the already existing, precisely divided preform and therefore a machine having special guiding precision is not necessary. In addition, the preform itself does not have to be inserted in a targeted way into the calibration tool, because all 8 tracks, for example, are initially identical, and are produced differently from these identical tracks in the calibration tool.

Furthermore, it may be advantageous to construct and/or produce the cage centering faces as described in U.S. Pat. No. 7,396,284, the disclosure of which is incorporated herein by reference, in the joint external part according to the present invention.

These cage centering faces in the external joint may be constructed in such a way that channels or grooves extending in the axial direction are provided between each of the adjacent first and second cage centering faces, the curvatures of the bases of these channels or grooves at least partially deviating in their axial course from the curvatures of the cage centering faces. These track bases—viewed in the axial direction—may also at least partially run approximately axially-parallel.

Like the grooves and projections for the ball contact lines or raceways, the cage centering faces may also be produced in a chipless manner in a preform in a forming tool as adjacent radial projections having a groove provided between them which at least runs axially-parallel, the two projections each being provided between two adjacent raceways.

This preform may also be produced by forging, for example. The cage centering faces are advantageously formed finished by chipless deformation, such as calibration, of the particular projections adjacent to a groove, the cage centering faces adjacent one another each running originating from one end, e.g., the drive-side end, in the direction toward the output-side end, approaching the axis of the external joint, and the second cage centering faces running originating from the output-side end in the direction toward the drive-side end and approaching the internal hub axis.

In the same way as described in connection with the raceways, the structures of the grooves and/or the projections of the preform may also be at least partially maintained here.

A further embodiment of the invention relates to a torque transmission unit having at least one component for transmitting torques via each of two functional areas formed onto the component and effecting the torque transmission by a form-fitting interengagement with other elements, at least one of the two functional areas being constructed as a profile, such as longitudinal teeth.

Such torque transmission units have become known, for example, from U.S. Pat. No. 6,872,143 in connection with side shafts and from US 2006/014587 (=DE 102 37 172) in connection with longitudinal shafts, for example.

In U.S. Pat. No. 6,872,143, two such components are provided for each of the fixed, constant velocity ball joints provided on both ends of the side shaft, on each of which different functional areas formed on the particular component are provided, which achieve the torque transmission by formfitting interengagement and one of which is constructed as longitudinal teeth.

One component is the joint external part, whose one functional area effects the torque transmission by formfitting interengagement is a connection pin having formed-on longitudinal teeth, which is provided on the joint external part, and whose other functional area transmitting the torque are the raceways in the joint external part for the balls of the joint.

The second component also having two functional areas for transmitting torque is the joint internal part having formed-on longitudinal teeth in the central internal area as one functional area and having formed-on ball raceways of the joint internal part as the other functional area.

In the torque transmission unit according to US 2006/014587, a component having two functional areas for transmitting torque is also provided for each of the three joints contained therein, namely a joint internal part having formed-on longitudinal or spline teeth as one functional area and formed-on ball raceways as the other functional area in each case.

In components of this type, i.e., joint parts, for example, the internal teeth are typically broached and the external teeth are typically produced by pounding, milling, or rolling, and the ball raceways are produced by machining or chipless.

To be able to transmit sufficient torque, at least the ball raceways are hardened. These raceways may be inductively hardened and the remaining area, i.e., also the longitudinal teeth, may be left at the basic hardness. This is favorable for the production of the longitudinal teeth, but does not permit the high torque values to be transmitted and the desired service life to be achieved, which are required in many cases.

The inductively hardened ball raceways, for example, must be machined hard because of the distortion occurring upon partial hardening after the hardening to achieve the acquired precision, i.e., hard milling or grinding must be performed.

Another known possibility is to first manufacture the teeth in the soft state, to case-harden the entire part, i.e., having formed-on longitudinal teeth, which results in hardening distortion of both the teeth and also the spline teeth, however, which may only be remedied in the longitudinal teeth with additional great effort, namely by hard broaching in the hard layer using corresponding suitable, but costly special machines and tools, for example.

The further solution on which the invention is based is achieved in that in a torque transmission unit, which has at least one component having two functional areas for transmitting torque, and one of the functional areas being constructed as a longitudinal profile, in particular as longitudinal

5

teeth, the component as a whole is hardened, but the longitudinal teeth have a lower hardness than the other functional area, but a higher hardness than the base hardness of a joint external or internal part, i.e., the longitudinal teeth have a lower hardness than the ball raceways, but a hardness exceeding the base hardness at least over partial areas of their radial extension.

In particular, hardening with which at least a specific hardening depth results, i.e., the base hardness of the workpiece is increased at least approximately over the height of the teeth, may be advantageous. In an especially advantageous way, a hardening process connected to a diffusion process, such as cost-effective surface hardening in the form of case hardening with subsequent quenching and annealing, may be suitable, which results in a high boundary hardness and—at least for the components discussed here—a lower hardness, the core hardness, i.e., a hardness exceeding the base hardness, in the areas lying within the areas having boundary hardness. Nitration or boration may also be suitable as the hardening process.

It has been found that after at least approximate removal of the areas having boundary hardness, e.g., by a lathing process, in the axial area in which the teeth are formed, this may be performed here using the machines and tools under practically identical conditions as the machining of “soft”, unhardened material, i.e., for example, on typical broaching-milling-pounding machines or similar machines.

The second functional areas, i.e., the ball raceways here, may be hard milled and/or ground within the zones of the boundary hardness, as is known. A very special, separate, and independent aspect according to the invention, however, is the creation of a component and the provision of a method for producing such a component, at least one of which is provided in a torque transmission device, which has two different functional areas for transmitting torque which are formed on the component and cause the torque effect the transmission of torque by formfitting interengagement, one of which is constructed as longitudinal teeth and the other functional area being, for example, the raceways for the balls of a joint, the component, however, in particular one of the functional areas being produced chipless and subsequently hardened, in particular surface-hardened, as described at the beginning, and the component further being distinguished in that the formed-on ball raceways are or were not subject to machining, the ball raceways are thus in installable state after the hardening procedure. In particular for such joints, inventive measures according to the claims and/or measures mentioned in the description may also be applied.

To produce a component of this type, it may be advantageous to subject the component as a whole to surface hardening, in particular a case hardening process, with a subsequent quenching and annealing procedure. The hardest area, i.e., the boundary layer and possibly the transition area, is partially removed, e.g., by chip removal, thus by lathing, for example, in the axial area on which the longitudinal teeth are to be applied, and subsequently the longitudinal teeth are formed in the area brought to the so-called core hardness by the hardening procedure and the subsequent annealing.

These longitudinal teeth may, as already noted, be produced in particular by machining, e.g., by broaching and specifically by “soft broaching”, i.e., using normal tools and machines, because they allow the broaching in the core hardness in the same way as with parts which only have the base hardness.

At relatively low cost and without requiring provision of special machines, the invention ensures rapid and efficient production of the longitudinal teeth with sufficiently high hardness and also a correspondingly high strength and, by the

6

possibility of using the so-called soft broaching, the production of longitudinal teeth having higher precision and service life.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described in further detail with reference to illustrative preferred embodiments shown in the accompanying drawing figures in which:

FIG. 1 shows a drive configuration for a motor vehicle having two partial shafts and an approximately centrally situated cardan joint,

FIG. 2 shows a cross-section through the cardan joint corresponding to a section along line A-A of FIG. 3,

FIG. 3 shows a section along line E-E of FIG. 2,

FIG. 4 shows a section along line C-C of FIG. 2,

FIG. 5 shows a section along line D-D of FIG. 2,

FIG. 6 shows a section along line B-B of FIG. 2,

FIG. 7 shows a view from the direction of the arrow X of FIG. 3,

FIG. 8 shows a view from the direction of the arrow Y of FIG. 3,

FIGS. 9-12 show a joint internal part as unfinished and finished parts,

FIGS. 13-17 show a joint external part as unfinished and finished parts.

FIG. 18 shows a torque transmission unit according to a further embodiment of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The driveshaft 1 shown in FIG. 1 is constructed here as a longitudinal driveshaft of a motor vehicle and comprises two partial shafts 2 and 3, which carry connection parts 4, 5 on their free ends. These connection parts are constructed as flexible rubber couplings, although cardan joints may also be fastened to the cited partial shafts 2 and 3 in their place, as described in US 2006/014587 or U.S. Pat. No. 6,893,352 (=DE 100 32 853).

The two partial shafts 2 and 3 are connected to one another via a cardan joint 8, which is shown in various sectional illustrations in FIGS. 2 through 8, approximately in the middle of the drive configuration 1. In addition, FIG. 1 shows that the left partial shaft 2 is fastenable to the underbody of a motor vehicle via an intermediate bearing 6 and a retainer 7 situated thereon.

As can be seen in particular from the sections according to FIGS. 2 through 6 and FIG. 9, which show the cardan joint 8 not connected to the partial shafts 2 and 3, the cardan joint primarily comprises an essentially hollow-cylindrical external hub 16, in which an internal hub 10 is situated coaxially. While the first partial shaft 2 may have its external spline teeth inserted into internal spline teeth 11 of the internal hub 10, the connection of the external hub to the second partial shaft 3 is performed in the present exemplary embodiment by a welded bond, for which a welding flange 12 is constructed on a driver housing 9. The external hub 16 is accommodated in the driver housing, and is enclosed in a formfitting way in a receptacle area 17.

First external ball running channels 19 for a first array of balls 14 and further external ball running channels 19a for a second array of balls 14a are provided on the interior side of the external hub 16. Webs 20 are located between them in each case.

First internal ball running channels 18 for the first array of balls 14 and further internal ball running channels 18a for the

second array of balls **14a** are provided on the exterior side of the internal hub **10**. Webs **28** are located between these ball raceways in each case.

The track base of the ball grooves is identified in each case by **18'**, **19'** and **18a'** and **19a'**.

The internal hub **10** has an internal hub axis I and an external face **24**. As can be seen from FIGS. **3**, **7**, **8** in particular, the first internal running channels **18** and the second internal running channels **18a** are situated distributed alternately around the internal axis I, the first internal running channels **18** running here originating from the drive-side end **2a** in the direction toward the output-side end **3a**, and the internal running channels and their track base **18'** moving away from the internal hub axis I; as can be seen from FIGS. **4** and **7**, **8** in particular, the second internal running channels **18a** run here from the output-side end **3a** in the direction toward the drive-side end **2a**, these second internal running channels and their track base **18a'** moving away from the internal hub axis I here. The first and second internal running channels having their opposing first and second external running channels may also be situated in a sequence other than alternately with one another and may have other courses than described and shown here, e.g., a course first moving away from the corresponding axes and subsequently approaching them again.

The external hub **16** has an external hub axis II and an internal contour, in which first ball running channels or raceways **19** for the first array of balls **14** and second ball running channels or raceways **19a** for the second array of balls **14a** are situated distributed alternately around the external hub axis II and in each case the first internal running channels **18** are opposite to the first external running channels **19** and the second internal running channels **18a** are opposite to the second external running channels **19a** and form a pair with them in each case, the first external running channels **19** running originating from the drive-side end **2a** in the direction toward the output-side end **3a**, and the external running channels **19** and their track base **19'** approaching the external hub axis II, and, furthermore, the second external running channels **19a** run originating from the output-side end **3a** in the direction toward the drive-side end **2a**, and the second external running channels **19a** having their track base **19a'** approach the external hub axis II (FIGS. **3** and **4**).

In an annular cage **15** having an at least sectionally spherical external face **26** (see FIGS. **2**, **5**, and **6** in particular), which is situated between the internal hub **10** and the external hub **16**, radial windows **27**, in which the balls **14**, **14a** are guided (see also FIGS. **3**, **4**) are provided in accordance with the number of the balls **14**, **14a** and/or running channel pairs **18**, **18a**, **19**, **19a**. The cage **15** is centered in the external hub **16** via its external face **26**, more precisely via the two centering areas **26a**.

Webs **20** are provided between the balls in the internal face of the external hub **16**, as already noted. As may be seen in particular in connection with FIGS. **4**, **6**, **8**, and **9**, viewed from the drive-side end **2a** and around the circumference, these webs have insertion contours **16a** primarily provided on both sides of the ball grooves **19** for the balls **14** for the axial insertion of the cage **15** into the external hub **16**. The insertion contours **16a** originate on the driver side **2a** from a diameter which at least approximately corresponds to the external diameter of the cage **15**.

Viewed in the axial direction, starting from the drive-side end **2a** of the joint, these insertion contours merge after at least approximately half of the axial length into the cage centering faces **16b** on the joint external part for the cage and are inclined in the direction toward the cage centering axis III

(see FIGS. **3**, **5**, **7**, and **8**). The cage centering faces **16b** are correspondingly adapted as crowned to the spherically constructed contact faces of the ball cage.

Viewed in the axial direction, originating from the output-side end **3a** of the joint, these insertion contours **16c** merge after at least approximately half of the axial length of the cage into the second cage centering faces **16b** on the external hub for the cage. From there, they run inclined in the direction toward the cage centering axis III. The second cage centering faces **16b** are correspondingly adapted as crowned to the spherically constructed contact faces **26b** of the ball cage, like the first faces.

As already noted, FIGS. **9-12** show a joint internal part as the unfinished part and finished part **R10** and **F10** and FIGS. **13-17** show the joint external part as the unfinished part and finished part **R16** and **F16**.

The preform **R10** according to FIG. **9** is a forged part having four pairs of projections or webs **R20**, **R20a**, which are distributed uniformly around the circumference and are constructed at least approximately uniformly, between which grooves or notches **R18**, **R18a** having groove bases **R18'** and **R18a'**, which run at least approximately axially parallel, are provided.

The preform **R10** may also be produced, as already noted, using a hot-cold or warm-cold process, for example, or also as a sintered part.

The running channels **F18**, **F18a** apparent from FIGS. **10**, **11**, and **12** are deformed from the projections or webs **R20**, **20a** by calibration in a tool which consists of two tool halves having plungers running in opposite directions to form the opposing running channels **F18**, **F18a**, using a cold deformation method, in particular by calibration.

The groove bases **R18'** and **R18a'** according to FIG. **9** remain at least partially maintained even after the calibration, as do partial areas **F18''**, **F18a''** according to FIGS. **10-12** from the lateral flanks **R18''** and **R18a''** previously contained in the preform **R10**. Only the crosshatched sections **F18'''** and **F18a'''** were deformed, as can be seen in particular from FIG. **10**. The faces **F18'''** and **F18a'''** are deformed in such a way that ball running lines or ball contact lines **F18b** and **F18b'** arise, along which the balls move upon the deflection of the joint.

Furthermore, it is apparent in particular in connection with FIG. **12** that the ball raceways **F18b** and **F18b'** and the remaining areas of the groove bases **F18'** and **F18a'** have different curvatures.

FIGS. **13-17** show unfinished and finished parts of the external joint **R19** and **F19**, FIGS. **16** and **17** showing FIG. **15** along lines A-A and B-B.

The preform **R16** according to FIG. **13** is produced here as a forged part having first and second projections or webs **R28**, **R28a** and **R28'**, **R28a'**, which extend radially inward. The projections **R28** and **R28a**, which run at least approximately axially-parallel, are designed as at least approximately mirror-image, like the projections **28'** and **28a'**.

The projections **R28** and **R28a** each enclose a first groove or notch **R19** between them, which runs at least approximately axially-parallel, as the projections **R28'** and **R28a'** enclose a second groove or notch **R19a** between them.

The projections **R28a** and **R28'** as well as **R28a'** and **R28** each enclose a third groove **R31** between them.

The grooves **R19** and **R19a** each have groove bases **R19'** and **R19a'** and the grooves **R31** each have groove bases **R31'**.

The grooves **R19** and **R19a** also have side flanks **R19''** and **R19a''**. The joint external part is produced as a finished part **F16** by a calibration procedure. The first and second ball

running channels **F19** and **F19a** of FIGS. **14-17** are deformed from the side flanks **R19''** and **R19a''** of FIG. **13**.

The groove bases **R19'**, **R19a'** of FIG. **14** are maintained at least approximately over the axial extension thereof as the track bases **F19'**. Only the crosshatched sections **F19'''** and **F19a'''** in FIGS. **16** and **17** are deformed of the side flanks **R19''** and **R19a''** and the ball contact lines or ball running areas **F19b** and **F19b'** are thus formed.

It is also apparent here that the curvature of the groove bases **F19'** differs from that of the contact lines **F19b** and **F19b'**.

The second channels **F19a** are produced in the same way as the first running channels **F19**, but in the opposite direction, i.e., restricted to the channels **F19**.

On both sides of the groove **F19**, insertion contours **F16a** running at least approximately in the axial direction are produced from the first projections **R28** and **R28a**, expediently by the same calibration procedure in which the contours **F19**, **F19a**, **F19'''**, **F19a'''**, **F16b**, **F16b'** are generated.

In the further axial course of the insertion contours **F16b**, the cage centering areas **F16b** are provided on both sides of each channel **F19**, a stepped projection or transition area being provided between the contours **F16b** and **F16a**.

The cage centering areas **F16b** and **F16d** are adapted to the spherical contact faces **26b** of the ball cage **15**.

In the same way, but with opposing restriction, the cage centering faces **F16d** and the insertion faces **F16c** are produced and/or constructed on both sides of the channels **F19a**.

FIG. **18** shows a further idea according to the invention on the basis of fixed, constant velocity joints, as are shown, for example, in US 2006/014587.

The fixed constant velocity joint **101** is comprised in a known manner of a joint internal part **102** having ball raceways **103**, as well as a joint external part **104** having ball raceways **105** formed thereon in a known way. Balls **106**, which transmit the torque between internal and external parts, are provided between the ball raceways **103** and **105** of joint internal and external parts **102** and **104**. A cage **107** is used for guiding the balls.

The joint internal part thus has functional areas for torque transmission in the form of the longitudinal teeth **108** on the one hand and in the form of the ball raceways **103** on the other hand.

The joint internal part is expediently a forged part having a central recess **108a** provided for the formation of the teeth. The ball raceways **103** may be produced, for example, by machining or chipless.

The joint internal part is initially subjected as a whole to a surface hardening, in particular a case-hardening process having quenching and subsequent annealing, for example. Before the formation of the teeth **108**, the area of greatest hardness of the recess **108a** is removed, for example, by machining, such as by lathing.

The internal teeth **108** may then also be produced by machining, for example, by broaching in a very simple and cost-effective work step which ensures high precision.

The ball raceways **103** may be ground—before or after the production of the teeth.

In the same way, joint external parts having external teeth provided on a pin may also be produced according to the invention, the external teeth also being able to be produced in a cost-effective way which ensures high strength and high

torque transmission values by machining or reshaping processing, e.g., by pounding, milling, rolling, or the like in an area which was previously hardened and in which the hardest areas were removed before the formation of the teeth. In a joint internal part, a pin may also have external teeth or a joint external part may have internal teeth.

The invention is not restricted to the torque transmission devices described here by way of example, but rather also extends to other torque transmission devices in which a component has two functional areas for transmitting torques by formfitting engagement with other elements.

The foregoing description and examples have been set forth merely as illustrations of the invention and are not intended to be limiting. Since modifications of the described embodiments incorporating the spirit and substance of the invention may occur to persons skilled in the art, the invention should be construed broadly to include all variations within the scope of the appended claims and equivalents thereof.

The invention claimed is:

1. A method for producing an internal or external part of an opposed track joint, said method comprising:

producing a preform having grooves with groove bases and lateral flanks, wherein said groove bases extend approximately axially parallel;

thereafter producing a final joint part from said preform by forming the grooves of said preform into tracks having track bases, which extend approximately axially parallel, and ball contact lines,

wherein:

the ball contact lines are produced by partially forming and partially maintaining the lateral flanks of the grooves, and

the approximately axially parallel extending track bases are produced by partially forming and partially maintaining said groove bases.

2. A method as claimed in claim **1**, wherein some axial areas of said grooves or said groove bases or said lateral flanks are formed and some axial areas of said grooves or said groove bases or said lateral flanks are maintained to achieve said tracks.

3. A method as claimed in claim **1**, wherein the curvatures of said track bases are formed in such a way that said track bases in their axial course at least partially deviate from the curvatures of said ball contact lines.

4. A method as claimed in claim **1**, wherein said preform is produced in a chipless manner in a forming tool.

5. A method as claimed in claim **4**, wherein said preform is produced by forging.

6. A method as claimed in claim **5**, wherein said preform is produced by cold forging.

7. A method as claimed in claim **5**, wherein said preform is produced by hot forging.

8. A method as claimed in claim **4**, wherein said preform is produced by sintering.

9. A method as claimed in claim **1**, wherein said lateral flanks are partially formed by chipless formation in a forming tool to achieve said ball contact lines.

10. A method as claimed in claim **1**, wherein said lateral flanks are partially formed in a calibration tool to achieve said ball contact lines.